Technical Memorandum

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SUBJECT: **DRAFT HYDROGEOLOGIC CONCEPTUAL MODEL: GROUNDWATER CONDITIONS IN THE SANTA CLARA RIVER VALLEYGROUNDWATER BASIN, EAST SUBBASIN**

INTRODUCTION

This technical memorandum (TM) presents a description of groundwater conditions present in the Santa Clara River Valley Groundwater Basin, East Subbasin (Basin). Following are the elements discussed in this TM:

- Groundwater occurrence, flow direction, and vertical gradients in each principal aquifer
- Primary use or uses of each aquifer
- General water quality of principal aquifers
- Subsidence

GROUNDWATER OCCURRENCE, FLOW DIRECTION, HORIZONTAL AND VERTICAL GRADIENT

The occurrence and movement of groundwater in the Basin are described in this section. Water level contours for seasonal high and seasonal low conditions for water year (WY) 2018 are presented as it is the most recent year with a complete dataset. WY is a term that refers to the 12-month period from October 1 through September 30 for any given year for which precipitation and surface water supply totals are measured (**Figure 5-1**).

Seasonal high groundwater conditions occur in the winter and early spring between January and April. This time frame is generally associated with the least amount of groundwater pumping and the greatest amount of recharge from rainfall. The greatest amount of precipitation in WY 2018 occurred in January (3.18 inches) and March (7.5 inches). Seasonal low conditions occur at the end of the water year following the summer and early fall which are associated with the least amount of recharge form precipitation and the greatest amount of groundwater pumping. Historic groundwater elevation data are presented in hydrographs for wells that are representative of conditions in each principal aquifer. There are two principal aquifers in the Basin: alluvial aquifer and the Saugus Formation. The aerial extent of each of these aquifers are presented in **Figure 5-2** and described in the following sections. The aerial extent of these aquifers has been generalized to conform to the Bulletin 118 Basin boundary.

Alluvial Aquifer

Groundwater Occurrence

The alluvial aquifer is the upper most principal aquifer in the Basin. Primary sources of recharge include the Santa Clara River, recharge from the Saugus Formation, and mountain front recharge (**CLWA, 2003**). Sources of manmade recharge include infiltration of irrigation water, infiltration of stormwater runoff from urban areas, infiltration of surface flow and underflow from Castaic Dam, infiltration releases by LADPW from its reservoir facilities in the San Francisquito and Bouquet Canyon area, and infiltration associated with discharges from the water reclamation plants.

Discharge from the alluvial aquifer occurs through pumping of irrigation and municipal supply wells, discharge to the Santa Clara River in the western portion of the basin, subsurface discharge to the neighboring Piru Basin to the west, and evapotranspiration (ET) by riparian vegetation. Discharge also occurs in the east in the form of seepage to the underlying Saugus Formation.

Flow Direction - Water Level Contours

Figures 5-3 and 5-4 present water level contours for seasonal high and seasonal low conditions for 2018. Under seasonal high conditions, groundwater depths range between 10 feet and 150 feet below ground surface (bgs) with groundwater elevations between 878 and 1888 ft above mean sea level (msl) using the North American Vertical Datum (NAVD88). Groundwater flow is toward the Santa Clara River on the flanks of the basin and to the west in the lower portions of the valley along the Santa Clara River (refer to the groundwater contour map, **Figure 5-3**). Under seasonal low conditions, groundwater depths range between 12 feet and 150 feet bgs with groundwater elevations between 877 and 1887 ft msl. Contours are not shown where there is a lack of water level data. The groundwater flow directions in the seasonal low conditions are similar to seasonal high directions. (**Figure 5-4**). During both seasonal high and seasonal low conditions, the highest groundwater elevations occurred in the northeastern part of the Basin and the lowest occurred in the southwest part of the Basin. For WY 2018, there was minimal variation between seasonal high and seasonal low groundwater conditions. Groundwater flow conditions based on 2018 data are consistent with the observation of **RCS 1986** and with water level contours presented in the Salt and Nutrient Management Plan for 2016 (**CLWA, 2016**).

Water Level Hydrographs

Historic water level trends for representative wells are presented in **Figures 5-5 & 5-6**. The representative wells presented in these hydrographs are located in different areas of the Basin and illustrate groundwater levels in the alluvial aquifer (**Figure 5-7**). **Figure 5-5** includes wells in the eastern part of the Basin (Mint Canyon, Santa Clara River area above Saugus WRP, and Bouquet Canyon) where water levels are heavily influenced by climatic conditions and seasonal pumping. Wells in the Mint Canyon area and Santa Clara River area above the Saugus WRP all exhibit a similar pattern of gradual declines over five to 10-year periods of below normal rainfall, followed by rapid recoveries during wet periods. Wells in the eastern portion of the Basin have shown substantially lower water levels during extended drought periods (e.g., 2011 – 2016), causing a reduction in well production in this area. Over the past 10 years, the average seasonal variation between high and low conditions in the Mint Canyon and above Saugus WRP area was approximately 16 feet. Over drought periods, water levels can decline by as much as 70 feet, which occurred in SCWD-N. Oaks Central from 2011 through 2016. Wells in the

Bouquet Canyon area show a less rapid decline and recovery. Over the past 30 years, these wells have exhibited stable water levels with periods of rising levels during wet periods and declining water levels during droughts. Over the past 10 years, the average seasonal variation in water levels was approximately 10 feet. Over drought periods, water levels declined by as much as 50 feet which occurred at SCWD-Guida from 2011 through 2016.

Figure 5-6 represents the historical groundwater levels measured in wells located in the western part of the basin (San Francisquito Canyon, Santa Clara River below Saugus WRP, Castaic Valley, and below Valencia WRP). Groundwater levels in the western part of the basin exhibit similar trends to those in the eastern portion of the basin (San Francisquito and below Saugus WRP) VWD-W11, VWD-9, VWD-Q2, and NLF-W5. However, the magnitude of water level declines during periods of reduced rainfall are less due to the recharge from the two WRPs and the upward vertical gradient from the Saugus Formation into the alluvial aquifer. This influence is indicated in the hydrograph for well VWD-I. Over the past 10 years, the average variation between seasonal high and seasonal low water levels was approximately 10 feet. Over drought periods, water levels have ranged between 20 and 50 feet as exhibited in VWD-I and VWD-W11 from 2011 through 2016, respectively. All the alluvial aquifer wells completed in the Castaic Creek drainage and the western portion of the Basin below the Valencia WRP along the Santa Clara River remained steady over various hydrologic cycles. Over the past 10 years, the average variation between seasonal high and low water levels on average is approximately 9 feet, similar to other areas of the alluvial aquifer in the western portion of the Basin. Over drought periods, water levels have declined by as much as 40 feet as exhibited in VWD-D from 2011 through 2016. Other wells such as NLF-B10 and NLF-B4 have shown almost no change in water levels over dry periods. Historic groundwater elevations for all alluvial aquifer wells having long-term monitoring data are presented in hydrographs in **Appendix A.**

Saugus Formation Aquifer

Groundwater Occurrence

The Saugus Formation Aquifer underlies the alluvial aquifer and is present throughout the entire Basin. The primary sources of recharge include percolation from the alluvial aquifer (particularly on the east end of the basin), direct recharge from precipitation, and inflow from outside the basin (**CLWA, 2003**). Discharge from the Saugus Formation is primarily from groundwater extraction and flow to the alluvial aquifer in the western portion of the Basin (**CH2MHill, 2004**).

Flow Direction - Water Level Contours

Under seasonal high conditions, groundwater depths range between 50 and 185 feet bgs with groundwater elevations ranging between 964 and 1190 ft msl (**Figure 5-8**). Water level measurements across the Saugus Formation are limited, but the general groundwater flow direction is predominantly east to west toward Interstate 5. West of Interstate 5, data is limited, however, the direction of flow is from the northwest to southeast. During seasonal low conditions, groundwater depths range between 50 and 217 feet bgs and groundwater elevations range between 956 and 1192 ft msl (**Figure 5-9**). The direction of flow during seasonal low conditions is similar to seasonal high directions. Groundwater flow conditions based on 2018 water level measurements are similar to the contours presented for the Fall 2000 in **CH2MHill 2004**.

Water Level Hydrographs

Historic water level trends for representative wells are presented in **Figure 5-10** and well locations are illustrated in **Figure 5-11**. The availability of groundwater level data for the Saugus Formation is limited to two areas (South and Central/West) and groundwater elevation data extends to the mid 1960's in only one well. VWD-160, with the longest period of record, shows a trend of gradual rising and falling groundwater elevations in response to wet and dry periods with historic highs occurring in the mid 1980's. Two dry periods that occurred in the early 1990s and the early 2010s , resulted in groundwater levels declines of approximately 100 ft. Following the first dry period, groundwater levels recovered, however full recovery from the most recent dry period has not occurred by 2019. All of the Saugus Formation wells show this general trend. The downward trend in the most recent dry period in the 2010s was a result of lower amounts of recharge rather than from an increase in groundwater extractions from the Saugus Formation. In recent years in the South Area groundwater levels have shown an upward trend (NWD-11 and VWD-159) due to increased rainfall since 2016. Over the past 10 years, the average variation between seasonal high and seasonal low water levels in the south area was approximately 18 feet, and the average variation in the central/west area was approximately 16 feet. All available historic water level data for Saugus Formation wells are included in **Appendix A**.

Horizontal Gradient

Alluvial Aquifer

The horizontal hydraulic gradient is as high as 0.018 ft/ft (95 ft/mile) in eastern portions of the Basin in the Mint Canyon area and as low as 0.005 ft/ft (29 ft/mile) in the west along the Santa Clara River (**Figure 5-3**). Under seasonal low conditions, the gradient in the east is the same as seasonal high conditions at approximately 0.018 ft/ft (95 ft/mile), but with a slightly steeper gradient in the west at 0.006 ft/ft (31 ft/mile) (**Figure 5-4**).

Saugus Formation

Under seasonal high conditions, the horizontal hydraulic gradient is approximately 0.008 ft/ft (42 ft/mile) (**Figure 5-8**).Under seasonal low conditions, the hydraulic gradient is approximately 0.007 ft/ft (35 ft/mile) (**Figure 5-9**). Gradient values are based on groundwater flow from east to west.

Vertical Gradient Between Principal Aquifers

The vertical gradient between the alluvial aquifer and Saugus Formation is the mechanism to assess flow between the two aquifers in either an upward or downward direction. For example, if the water level in the alluvial aquifer is higher than the water level in the Saugus Formation, there is the potential for groundwater to move vertically from the alluvial aquifer to the Saugus Formation. The reverse can also occur. The magnitude and direction of vertical gradients were determined based on the average seasonal high-water level over the past 10 years at two locations in the Basin where groundwater level data from Saugus Formation wells is generally available. The average vertical gradient was determined in the vicinity of Saugus well VWD-201 located in the South area, and at the the Saugus well VWD-207 area located in the western portion of the Basin. Results are presented in Table 5-1. The negative value in the South area indicates a downward gradient. The positive values indicate an upward gradient from the Saugus Formation to the Alluvial aquifer. These estimates are based on available groundwater level measurements in both aquifers.

Table 5-1 – Approximate Aquifer Vertical Gradient

Basin Area	Aquifer – Seasonal Condition	Average GWE	Gradient (ft/ft)
South Area	Alluvial – VWD All. Mon	1079	-0.04
	Saugus – VWD 201	1024	
Western Area	Alluvial – VWD-E14	983	0.003
	Saugus – VWD-207	984	

Change in Groundwater Storage

Change in groundwater storage can be estimated using groundwater elevation data from successive seasonal high periods, or using water budget results from a groundwater flow model. The change in storage of water using the change in water level approach is a function of aquifer storage coefficients, amount of water level change, and areal extent of water level changes. A change in storage calculation using the water budget approach calculates the difference between recharge and discharge terms. The water budget approach will be utilized utilizing the basin groundwater flow model for each of the principal aquifers when it is available. The groundwater flow model will calculate the change in groundwater storage for the historical, current, and projected water budget periods. The results of these calculations will be made available for review once the model is updated and water budgets are developed for the GSP.

Subsidence

According to the U.S. Geological Survey (USGS), land subsidence is a phenomenon found across the United States, affecting the land surface of over 17,000 square miles in 45 states (Galloway et al., 1999). Land subsidence in California is commonly a result of fluid withdrawal (oil, or groundwater). The principal causes of land subsidence are aquifer system compaction (caused by reduction in hydraulic head affecting the physical structure and orientation of clay minerals and drainage of organic soils. Subsidence can occur in two forms, elastic and inelastic (or permanent).

When discussing the potential for land subsidence in any area, it is important to consider the type of subsurface materials that could contribute to subsidence combined with pumping records and groundwater level measurements through a substantial period of record. The Saugus Formation contains lenses of silt and clay throughout; however, these materials are not laterally continuous and have not experienced extended periods of groundwater level declines that would result in permanent subsidence. Through the last nineteen years of reviewing and reporting on the geology and water resources in Basin, there has not been evidence of chronic groundwater level declines that would contribute to subsidence (**LSCE, 2017**).

As of February 2020, land surface elevation is being monitored at two continuous global positioning system (CGPS) sites in the Basin as reported by UNAVCO from its Data Archive Interface (http://www.unavco.org/data/data.html). Data collection has been ongoing since the early 2000's with daily measurements. Subsidence data was also obtained from the Department of Water Resources SGMA Data viewer. The TRE Altamira InSAR Dataset contains vertical displacement data from October 2018 through September 2019. These data were collected by the European Space Agency Sentinel-1A satellite and processed by TRE Altamira. The dataset covers more than 200 groundwater basins across the state at a resolution of approximately 100 square meters.

The locations of the UNAVCO CGPS sites along with historic vertical displacement data are presented in **Figure 5-12.** The relatively stable trend of these plots indicate that no long-term subsidence is occurring. Since the beginning of data collection in the early 2000's at both locations, the net vertical displacement is positive (0.05 ft) at the CTDM site and zero at the SKYB site. This means that the land surface has actually risen (positive displacement) or stayed the same. In any given year, the vertical displacement is generally less than 0.05 feet, with the exception of 2006 to 2007 at the SKYB site. Within the context of complex southern California geology, the elevation change (less than 0.2 feet vertical change over the last 20 years) seen at the two UNAVCO stations is likely due to tectonic activity and groundwater extraction has not resulted in any subsidence.

Vertical displacement for a single year period over the entire Basin from the TRE Altamira InSAR dataset is presented in **Figure 5-13**. From October 2018 through September 2019, vertical displacement values in the Basin ranged between -0.25 and +0.25 feet. To obtain the most accurate data on inelastic subsidence it is best to estimate subsidence from a comparison of data collected in the winter or early spring to avoid incorporating elastic or temporary subsidence that can vary from year to year. Because the satellite data was developed from an early fall to early fall time frame, it likely is not a reliable indicator of inelastic or permanent subsidence. In addition, the resolution of satellite data for subsidence monitoring is not as accurate as ground-based data collection.

Primary uses of each Aquifer

Groundwater production rates presented in this section for municipal/industrial, agricultural, domestic water users were obtained from the 2018 Santa Clarita Valley Water Report (**LSCE, 2019**). Each is summarized in the following section.

Municipal/Industrial

Municipal/Industrial groundwater production for both the alluvial aquifer and the Saugus Formation from 1980 to 2018 are presented in **Figure 5-14**. Groundwater production in the alluvial aquifer has ranged from 8,684 to 27,919 acre-feet/year (AFY) with an average of 19,400 AFY. Production increased until the late 1990's, after which production remained at this level until 2015 when it began to decline rapidly. Saugus Formation production has ranged from 2,728 to 14,417 AFY with an average of 6,075 AFY. Saugus Formation production peaked in the early 1990's for a short period before reaching its lowest point in 1999. Production gradually returned to normal levels and was relatively stable thereafter.

Agricultural

Agricultural production for both the alluvial and Saugus Formation aquifers from 1980 to 2018 are presented in **Figure 5-15**. Alluvial production ranged from 5,951 to 13,824 AFY with an average of 10,194 AFY. Alluvial production has been relatively steady over the four decades presented in **Figure 5-15** with year to year variation typically within 2,000 AF. Agricultural production from the Saugus Formation has been minor. Presently, there is no agricultural production from the Saugus Formation.

Private Domestic Uses

Private domestic uses of groundwater constitute a minor percentage of the total groundwater extraction in the Basin. Private domestic also includes groundwater production used for golf courses. Total domestic groundwater extractions by aquifer are presented in **Figure 5-16**. Alluvial aquifer domestic well production values are estimated to range from 500 to 1,369 AFY with an average of 741 AFY.

Groundwater Quality

This section summarizes the general groundwater quality (natural and anthropogenic) for both principal aquifers based on previous technical studies and monitoring performed by SCV Water. Natural constituents discussed in this TM include total dissolved solids (TDS), chloride, nitrate, and sulfate. These constituents are naturally occurring in groundwater, but some constituents can also result from human activities.

Also discussed are human caused groundwater constituents of concern (COC) that have been observed in the Basin. The Santa Clarita Valley Water Report identifies perchlorate and volatile organic compounds (VOCs) as the primary human caused COC. The most frequently detected VOCs in the basin are Trichloroethylene (TCE) and Tetrachloroethylene (PCE). Less frequently detected compounds include Chloroform, and 1,1-dichloroethene which have been detected in trace amounts below the MCL in the basin (**LSCE, 2019**). The Salt and Nutrient Management Plan (SNMP) prepared by SCV Water in 2016 identified dichlorodiphenyltrichloroethane (DDT) and polychlorinated biphenlys (PCBs) as other COC. A contaminant of emerging concern in the basin is perfluoroalkyl substances or PFAS.

Groundwater quality concentration data are expressed in terms of milligrams per liter (mg/L) or parts per million and also micrograms per liter (ug/L) or parts per billion (ppb). Historic and recent concentrations are compared to primary and secondary maximum contamination levels (MCL, SMCL) that are based on State Water Resource Control Board Division of Drinking Water (SWRCB DDW) and Environmental Protection Agency (EPA) standards. These are generalized standards for drinking water, which are set to protect public health. Groundwater quality concentrations are also compared to water quality objectives (WQO) as set by the Los Angeles Regional Water Quality Control Board (LARWQB) that are site specific based on location conditions. WQOs have been set by the LARWQB for the alluvial aquifer but not for the Saugus Formation . The SNMP identifies WQOs for TDS, chloride, and nitrate, but state that further analysis is necessary in order to establish meaningful WQOs (CLWA, 2016).

Water quality concentration graphs for TDS, chloride, nitrate, and sulfate are presented in **Appendix B**. Data through 2018 are included in the individual concentration graphs. A summary of groundwater quality data for each principal aquifer is presented below.

Groundwater Quality – Alluvial

Total Dissolved Solids

The amount of dissolved solids or salts in water is represented by TDS. Water quality in terms of TDS has been described in the Water Report prepared for SCV Water for about 20 years. Groundwater quality conditions in the alluvial aquifer are described for the different zones shown in **Figure 5-7**. The SWRCB DDW recommends an SMCL for TDS of 500 mg/L, with an upper limit of 1000 mg/L and a short-term limit of 1,500 mg/L. In addition to the SMCL, the WQO values range between 700 and 1,000 mg/L.

In the Mint Canyon and Above Saugus WRP areas (**Figure 5-17**), TDS concentrations show a long-term stable trend over the past 30 years with the exception of well VWD-U4 that has shown an increasing trend overall with concentrations above the WQO. Concentrations in this well have decreased over the past three years.

In Bouquet Canyon, TDS concentrations show long-term stable trends over the past 30 years with minimal variation and may be correlated with periods of flow in Bouquet Canyon Creek (**Figure 5-17**). TDS concentrations in Bouquet Canyon have ranged from approximately 400 to almost 900 mg/L historically. In 2018, TDS concentrations exceeded the historical range with a value of 910 mg/L in one of the wells in this area while another well was within the range. The WQO for Bouquet Canyon is 700 mg/L. The SNMP found that the average TDS concentration for this area was 710 mg/L, slightly above the WQO.

TDS concentrations in the western areas of the basin exhibited similar patterns and responses to wet and dry periods as those observed in the eastern portions of the Valley (**Figure 5-18**). TDS concentrations in San Francisquito Canyon and Below Saugus WRP areas historically have ranged from approximately 300 to 1,100 mg/L. In 2018, TDS concentrations were within historical ranges and ranged from approximately 580 to 960 mg/L. The WQO for San Francisquito Canyon and Below Saugus WRP is 700 mg/L.

In Castaic Valley and Below Valencia WRP areas, TDS concentrations have historically ranged between 300 to 1,100 mg/L (**Figure 5-18**). At times, variations in TDS concentrations appear to be related to wet and dry periods along with discharge from Castaic Lake. In 2018, there was only one analysis for TDS with a concentration of 460 mg/L, which is within the historic range. The WQO for the Castaic Valley and Below Valencia WRP areas is 1000 mg/L. The SNMP found that the average TDS in this area was 727 mg/L.

Box and Whisker plots illustrating summary statistics for TDS measured in wells located in each area are shown in **Figure 5-19.** This figure is based on data collected from 1990 through 2018. The largest range of values and highest concentration occurred in the Above Saugus WRP area. Below the Valencia WRP area displayed the smallest range but also the highest median value. San Francisquito Canyon has the lowest median TDS concentrations. Below Saugus WRP, Bouquet Canyon, and Mint Canyon all exhibited similar distributions of TDS concentrations.

Long-term groundwater quality monitoring data for TDS shows a consistent pattern of meeting drinking water standards, although it appears to be intermittently affected by wet and dry cycles. This supports the conclusion that the Alluvium remains a viable ongoing water supply source in terms of groundwater quality even with short-term exceedances of water quality standards in a few of the wells.

Chloride

Chloride is a naturally occurring inorganic salt, but higher concentrations in groundwater can be associated with anthropogenic activities such as urban runoff or discharge of recycled water (**CLWA, 2016**). High concentrations result in a salty taste when used for drinking water. The SCML for chloride recommended by SWRCB DDW is 250 mg/L, with and upper limit of 500 mg/L and a short-term limit of 600 mg/L. The WQOs for chloride range from 100 to 150 mg/L.

Chloride concentrations in the Mint Canyon and Above Saugus WRP areas have historically ranged from 17 to 160 mg/L. Values in 2018 were between 46 and 120 mg/L (**Figure 5-20**). Concentrations have increased and decreased over time likely due to wet and dry conditions. WQO for this area is 150 mg/L and all representative wells are currently below this level. The SNMP found that the average concentration for the Mint Canyon and Above Saugus WRP area was 89 mg/L and 72 mg/L, respectively.

Chloride concentrations in the Bouquet Canyon have ranged between 40 and 120 mg/L (**Figure 5-20**). Values in 2018 were between 94 and 120 mg/L. Historical data is available since the mid 1970's where chloride concentrations are generally stable and below the WQO of 100 mg/L. The SNMP found that the average concentration for this area is 77 mg/L.

Chloride concentrations in the San Francisquito Canyon and Below Saugus WRP areas range from 36 to 130 mg/L, with 2018 values between 62 and 130 mg/L (**Figure 5-21**). Similar to other alluvial areas, chloride concentrations are stable but with a small increase in recent years. WQO for this area is 100 mg/L. The SNMP found that the average concentration for this area is 77 mg/L.

In the Castaic Valley and Below Valencia WRP Areas, chloride concentrations have ranged between 55 and 180 mg/L with a single 2018 measurement at 97 mg/L (**Figure 5-21**). There has been a slight upward trend in chloride concentrations since the mid-1990s.

Chloride concentrations across the alluvial aquifer are presented statistically as Whisker plots in **Figure 5-22**. Chloride concentrations in the Above Saugus, Below Valencia, and Castaic Valley all have similar distributions. The highest median value occurred in the Below Valencia area and the lowest in the San Francisquito Canyon. The SNMP found that the average concentration for this area was 77 mg/L.

Nitrate

Nitrate is a compound that is associated with agricultural activities, septic systems, confined animal facilities, landscape fertilization, and water treatment facilities. Consumption of water with high concentrations of nitrate can have adverse health effects, specifically for infants under the age of six months who can develop methemoglobinemia or blue baby syndrome (**SWRCB, 2017**). The MCL and the WQO objectives for each of the management areas for nitrate concentration is 45 mg/L (**CLWA, 2016**).

In the Mint Canyon and Above Saugus WRP areas, nitrate concentrations have ranged between non-detect (ND) and 38 mg/L. There is no apparent trend of increasing nitrate concentration in the Mint Canyon and Above Saugus WRP areas (**Figure 5-23**). The average concentration identified in the SNMP for the Mint Canyon and Above Saugus WRP area were 20 to 21 mg/L, respectively.

Nitrate concentrations in the Bouquet Canyon Area have ranged from 3 to 34 mg/L. Values have not shown any increasing trend over time (**Figure 5-23**). Average concentration identified in the SNMP for this area was 16 mg/L.

Nitrate concentrations in the San Francisquito Canyon and the Below Saugus WRP area have ranged from ND to 50 mg/L. This area has exhibited a wide range of values dating back to the mid 1950's but has not shown any increasing trend over time (**Figure 5-24)**. Average concentration identified in the SNMP for this area was 16 mg/L.

In the Castaic Valley and Below Valencia WRP areas, nitrate concentrations have ranged from ND to 36 mg/L with the highest concentration occurring in the 1950's. There has not been an increasing trend in nitrate concentrations (**Figure 5-24**). Average concentration identified in the SNMP for this area was 8 mg/L.

Figure 5-25 includes Box and Whisker plots representing the statistical distribution of nitrate concentrations across the alluvial aquifer that includes data from 1990 to present. Median concentrations are all well below the MCL and WQO of 45 mg/L. The lowest median value is in Castaic area while the highest is below the Saugus WRP area.

Sulfate

Sulfate is naturally occurring in groundwater and can occur as a result as runoff from natural geological deposits and from industrial waste. Consumption of sulfate in high concentrations can have a laxative effect (**WHO, 2004**). The SMCL is 250 mg/L with an upper limit of 500 mg/L and a short-term limit of 600 mg/L. The WQOs for the alluvial aquifer range from 150 to 350 mg/L (**CLWA, 2016**).

In the Mint Canyon and Above Saugus WRP areas, sulfate concentrations have historically ranged between 34 and 538 mg/L (**Figure 5-26**). In the set of wells shown on **Figure 5-26**, all wells except VWD-U4 exhibit a similar steady trend with values less than the WQO of 150 mg/L and no long-term increasing trend. VWD-U4 has shown a very wide range of sulfate concentrations with values exceeding the WQO and SMCL. The last available measurement for this well was in 2014 with a concentration of 440 mg/L. 2018 values were between 78 and 140 mg/L, which were measured at VWD-T7 and SCWD-N. Oaks Central, respectively (**Figure 5-26**).VWD-U4 has had sulfate concentrations as high as 500 mg/L. The last measurement for this well was in 2014 with a concentration of 440 mg/L. The average concentration identified in the SNMP for the Mint Canyon and Above Saugus WRP area was 138 and 269 mg/L, respectively.

In the Bouquet Canyon area, sulfate concentrations have historically ranged from 89 and 260 mg/L. Values have shown little variation over time with a gradual increasing trend. 2018 values were 210 and 260 mg/L measured at SCWD-Clark and SCWD-Guida (**Figure 5-26**). The WQO for this area is 250 mg/L. The average concentration identified in the SNMP for this area was 189 mg/L.

In the San Francisquito Canyon and Below Saugus WRP areas, sulfate concentrations have historically ranged between 46 and 506 mg/L. The highest value occurred in the early 1960s. Since the early 1990's values have been consistent in this area, showing a gradual increasing trend. In 2018, sulfate concentrations were between 160 and 300 mg/L (**Figure 5-27**). The WQO for this area is 250 mg/L. The average concentration identified in the SNMP for this area was 189 mg/L.

In the Castaic Valley and Below Valencia WRP areas, sulfate concentrations have historically ranged between 89 and 606 mg/L (**Figure 5-27**). The historic high value occurred in the late 1960's with the historic low occurring in 2018. Wells in the area have exhibited a decreasing trend of sulfate concentration. The WQO for this area is 350 mg/L. The average concentration identified in the SNMP for this area was 246 mg/L.

Figure 5-28 is a Box and Whisker plot that presents the distribution of sulfate concentrations across the alluvial aquifer with data from 1990 to present. The greatest variation occurs in the Above Saugus WRP area with the highest median value in the Below Valencia WRP area.

Groundwater Quality – Saugus Formation

TDS

TDS concentrations for wells in the Saugus Formation are illustrated in **Figure 5-29**. Beginning in 2000, several wells within the Saugus Formation have exhibited an increase in TDS concentrations, similar to short-term changes in the Alluvium, possibly as a result of decreased recharge to the Saugus Formation from the Alluvium. From 2006 through about 2010, TDS concentrations had been steadily declining, followed by an increase through 2016 and a slight decrease in 2017/2018. TDS concentrations in the Saugus Formation remain within the range of historic concentrations and below the SMCL upper level. The WQO for the Saugus Formation is 700 mg/L. (**CLWA, 2016**). The average concentration identified in the SNMP was 636 mg/L. Groundwater quality within the Saugus Formation will continue to be monitored to ensure that the long-term viability of the Saugus Formation as a component of overall water supply is preserved.

Chloride

Chloride concentrations for representative wells are presented in **Figure 5-30.** Historic chloride concentrations have ranged between 17 and 420 mg/L. Chloride concentration in the Saugus Formation have been stable for the past 50 years. The WQO for chloride in the Saugus Formation is 100 mg/L. The average concentration identified in the SNMP was 28 mg/L.

Nitrate

Nitrate concentrations for representative wells are presented in **Figure 5-31.** Nitrate concentrations in the Saugus Formation have ranged from ND to 28 mg/L. Values have historically been stable but have shown higher concentrations in recent years, but are still well below the WQO of 45 mg/L. The average concentration identified in the SNMP was 14 mg/L.

Sulfate

Sulfate concentrations for representative wells are presented in **Figure 5-32**. Historic sulfate concentrations have ranged from 80 to 730 mg/L. The highest concentrations have been observed in VWD-159, which has not been sampled since 1998. Overall, sulfate concentrations have exhibited an increasing trend in recent years. The high sulfate in the Saugus Formation is mostly likely due to naturally occurring minerals present in the rock. The average concentration identified in the SNMP was 235 mg/L. A WQO for sulfate in the Saugus Formation is not identified in the SNMP.

Groundwater Constituents of Concern (Anthropogenic) in the Alluvium and Saugus Formation

Groundwater COC that have been measured in the Alluvium and Saugus Formation include perchlorate, per- and polyfluoroalkyl substances (PFAS), and volatile organic compounds (VOCs) such as trichloroethylene (TCE), and tetrachloroethylene (PCE). These contaminates have been identified in previous studies and are currently monitored under other state and federal regulatory programs (**LSCE, 2019; CLWA, 2016; CLWA, 2016a**).

Perchlorate and VOCs

Perchlorate is a regulated substance that is commonly used in propellants for rockets, missiles, and fireworks. Consumption of groundwater with high concentrations perchlorate can result in issues with the thyroid gland (**EPA, 2014**). There have been a number of detections in the basin, both in the alluvial aquifer and in the Saugus Formation. Perchlorate was first detected in the basin in 1997 and since has been detected in a total of eight wells. Wellhead treatment systems have been built for four Saugus Formation production wells operated by SCV water, with oversight from the California Department of Toxic Substances Control (**LSCE, 2019**).

PCE is a VOC that is commonly associated with dry cleaning and metal degreasing processes. Long-term exposure at levels near the MCL can result in cancer. Other adverse effects include damage to the liver, kidneys, and central nervous system (**SWRCB, 2017a**). Detections of PCE have primarily occurred in the alluvial aquifer, however, the concentrations have been below the MCL.

TCE is a VOC that is primarily associated as a solvent to remove grease from mental parts. Long-term exposure could result in cancer. Exposure can also affect the central nervous system with symptoms such as light-headedness, drowsiness, and headache (**SWRCB, 2017b**). Detections of TCE have primarily occurred in the Alluvial Aquifer, however, the concentrations have been below the MCL. **Table 5-2** presents the number of wells with detections above the reporting limit (RL) and MCL for each Perchlorate and VOCs of interest across the basin.

Table 5-2 – Wells with Perchlorate and VOC Detections

COC	Alluvial Wells With Detections > RL	Saugus Wells Detections > RL	RL	Max Concentration	MCL	Wells with Detections Above MCL	Units
PERCHLORATE	2	6	4	47	6	7	ug/L
PCE	15	1	0.5	4.4	5	0	ug/L
TCE	4	6	0.5	2.6	5	0	ug/L

PFAS

PFAS refers to the larger group of COC of per- and polyfluoroalkyl substances. Largely used in firefighting foams, non-stick coatings, cookware, carpets, and furniture, it tends to accumulate in groundwater and long-term exposure could potentially affect the immune system, thyroid, liver, and can cause cancer. The most common types of PFAS are perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). This is a contaminant of emerging concern that is not currently regulated. The SWRCB DDW have identified notification levels for PFAS concentrations that is a precautionary health-based measure for concentrations of chemicals in drinking water that warrant further monitoring and assessment (**SWRCB, 2019**).

The DTSC and LA Regional Water Quality Control Board are overseeing the monitoring of and response to detections of constituents of concern exceeding the MCLs. SCV Water is actively addressing the issue with the regulatory agencies and has taken wells out of service that have detections above reporting limits until wellhead treatment systems are deployed.

The following is a SCVWA News Release from March 13, 2020.

SANTA CLARITA –SCV Water has taken proactive steps to protect public health by voluntarily removing 13 of its groundwater wells from service. This move follows the State Water Resources Control Board – Division of Drinking Water (DDW) Feb. 6, 2020, decision to lower its response level guidelines for two chemicals found in low concentrations in drinking water across the state.

Voluntary quarterly sampling of all active wells was done in February, and this action is based on those results for perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS). The Agency did not find more or higher levels of the chemicals, but instead is taking action based on the lowered response levels set by the DDW.

The action this week is not related to the COVID-19 virus. The virus is not found in drinking water.

Under the new levels, 14 of the 44 agency wells are impacted. This accounts for approximately 34 percent of the Agency's groundwater supply. In 2019, groundwater accounted for just 28% of the total water used in the SCV Water service area. SCV Water will continue to rely on its diverse water supply portfolio, including imported and banked water, to minimize supply impacts to customers.

"SCV Water has a diverse and resilient water supply, so this action will not impact the availability of water to our customers," stated Matt Stone, general manager. "However, with some groundwater wells temporarily offline, it remains important that customers continue to use water efficiently in their homes and on their landscapes.

Last month, the DDW lowered its response levels to 10 parts per trillion (ppt) for PFOA and 40 parts per trillion (ppt) for PFOS. The state's previous response level set a combined 70 ppt for PFOA and PFOS. These response levels are some of the most stringent guidelines in the nation, and lower than the Environmental Protection Agency's Lifetime Health Advisory level of 70 ppt. For perspective, one part per trillion would be equal to four grains of sugar in an Olympic-size swimming pool.

The updated guidelines are part of DDW's statewide effort to assess the scope of water supply contamination by PFOS and PFOA.

"We have three quarters of sampling data we can factor in now, giving us a head start in addressing the new guideline," stated Matt Stone, general manager of SCV Water. "Our top priority is providing clean and reliable water to our customers. We immediately removed one well from service last year when it exceeded the original response level, and we have taken the same actions for the 13 additional wells that exceeded the revised response level."

SCV Water is also quickly moving forward with the construction of several water treatment plants to return affected wells back to service. The first PFAS treatment facility has started construction and is expected to be in operation by June of this year, restoring three key wells to service, which provides enough groundwater for 5,000 families. The fast-tracked project is estimated to cost $6 million to build and $600,000 annually to operate. Additional groundwater treatment facilities are in the planning and design phase.

"We are committed to clear and timely communication with our customers about all water quality changes and how we plan to address them," said Stone. "Our customers are our top priority, and we are committed to rigorously testing our water thousands of times per year to ensure it meets or surpasses all water-quality standards and is safe for our customers to drink."

Per- and polyfluoroalkyl substances (PFAS) are a group of manmade chemicals that are prevalent in the environment and were commonly used in industrial and consumer products to repel grease, moisture, oil, water and stains. Water agencies do not put these chemicals into the water, but over time very small amounts enter the water supplies through manufacturing, wastewater discharge and product use. Exposure to these chemicals may cause adverse health effects.

For more information and resources on PFAS, visit yourSCVwater.com/pfas.

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